REMARKS

This application has been reviewed in light of the Office Action dated May 23, 2001. Claims 1-5, 9-15, and 19-23 are pending in this application. Claims 6-8 and 16-18 have been canceled, without prejudice or disclaimer of the subject matter presented therein. Claims 1, 3-5, 11, 13-15, 19, and 21-23 have been amended to define more clearly what Applicants regard as their invention. Claims 1, 11, 22, and 23 are in independent form. Favorable reconsideration is requested.

A Claim To Priority and a certified copy of the priority document for this application were filed on November 19, 1999. Applicants respectfully request acknowledgment of the claim for foreign priority and receipt of the certified copy.

The Office Action objected to Claim 19, for a misspelling. Applicants have corrected this informality.

Claims 3-5, 13-15, 22, and 23 were rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. In addition, Claims 3-5, 13-15, and 21 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.

Applicants have carefully reviewed and amended the pending claims as deemed necessary to ensure that they conform fully to the requirements of Section 112, first and second paragraphs, with special attention to the points raised at pages 2-4 of the Office Action. Applicants note that "protective layer" and "protective layers" have been changed to --protective coating-- and --protective coatings--, respectively, throughout all the claims, as necessary. Applicants believe that the rejections under Section 112, first

and second paragraphs, have been obviated, and their withdrawal is therefore respectfully requested.

The Office Action rejected Claims 1, 2, 9, 21/1, and 22 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,339,762 (Shirato et al.).

Also, the Office Action rejected Claims 3-5 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,339,762 (Shirato et al.), in view of U.S. Patent No. 4,392,907 (Shirato et al.); Claim 10, as being unpatentable over Shirato et al. ('762), in view of U.S. Patent No. 4,429,321 (Matsumoto); Claims 11, 12, 21/11, and 23, as being unpatentable over Shirato et al. ('762) in view of European Patent Application No. EP-764,531 (Nakata et al.); Claims 13-15, as being unpatentable over Shirato et al. ('762) in view of Nakata et al., in view of Shirato et al. ('907); Claim 19, as being unpatentable over Shirato et al. ('762) in view of Nakata et al., and U.S. Patent No. 5,658,471 (Murthy et al.); and Claim 20, as being unpatentable over Shirato et al. ('762) in view of Nakata et al. and Matsumoto.

Applicants submit that Claim 1 is patentable over Shirato et al. ('762) for at least the following reasons.

The aspect of the present invention set forth in Claim 1 is a liquid discharge head apparatus that includes a heat generating element that is in contact with, and between, a pair of electrodes for generating thermal energy which is used for discharging liquid from a discharge port. A protective coating of the apparatus is provided on the heat generating element to protect it. The protective coating has a first region with a substantially uniform thickness along a direction connecting the pair of electrodes, and a second region with a substantially uniform thickness along the direction, with the second region being thinner

than the first region, the volume of a liquid droplet discharged from the discharge port is changed by changing electric energy applied to the heat generating element.

One important feature of Claim 1 is that the protective coating has a first region with a substantially uniform thickness along a direction connecting the pair of electrodes, and a second region with a substantially uniform thickness along the direction, with the second region being thinner than the first region. This feature of having a first and second region with substantially uniform thicknesses, with the second region being thinner than the first region, allows digital-like simple gradation recording to be obtained with high feasibility (see the specification at page 8, lines 12-21 and Figures 2A and 2B, where reference numeral 108 refers to the first region and reference numeral 109 refers to the second region.).

Shirato et al. ('762) relates to a liquid jet recording method that is capable of recording gradation that includes the following steps: A conduit having, at the end, an orifice for ejecting and projecting a liquid droplet in a predetermined direction is filled with a liquid. The conduit is provided with a heat actuating portion that generates a force for ejecting the liquid droplet by applying heat energy to the liquid to cause an abrupt state change. The heat actuating portion includes an electrothermal transducer that has a heat generating portion that has such a structure that the degree of heat supply is different from position to position on the heating surface. The strength of an input electric signal corresponding to the gradation of an image to be recorded is controlled, thereby controlling the distribution of degree of heat supplied at the heating surface. Applicants submit that Shirato et al. ('762) shows in Figure 4 a protective layer (see, e.g., reference numeral 406) that has a thickness gradient from the side of one electrode (see, e.g., reference numeral 404) to the side of another electrode (see, e.g., reference numeral 405), where the thickness

of the protective layer continuously varies for gradation recording. Applicants submit that Shirato et al. ('762) does not teach or suggest a protective coating that has a first region with a substantially uniform thickness along a direction connecting the pair of electrodes, and a second region with a substantially uniform thickness along that direction, with the second region being thinner than the first region, as recited in Claim 1. Accordingly, Applicants submit that Claim 1 is patentable over Shirato et al. ('762).

The aspect of the present invention set forth in Claim 11 is a liquid discharge head that includes a heat generating element that is in contact with, and between, a pair of electrodes for generating thermal energy which is used for discharging liquid from a discharge port. A protective coating is provided on the heat generating element to protect the heat generating element, and a moving member that faces the heat generating element, and has a free end which is displaced in accordance with generation of a bubble due to the thermal energy. The protective coating has a first region with a substantially uniform thickness along a direction connecting the pair of electrodes and a second region with a substantially uniform thickness along the direction, wherein the second region is thinner than the first region. The volume of a liquid droplet discharged from the discharge port is changed by changing electric energy applied to the heat generating element.

One important feature of Claim 11, similar to Claim1 above, is that the protective coating has a first region with a substantially uniform thickness along a direction connecting the pair of electrodes, and a second region with a substantially uniform thickness along the direction, with the second region being thinner than the first region.

Nakata et al. relates to a liquid ejection head that includes an ejection outlet for ejecting liquid and a bubble generating region for generating a bubble. A movable member is disposed faced to the bubble generating region and movable between a first

position and a second position which is farther from the bubble generating region than the first position. A liquid supply passage supplies the liquid to the bubble generating region from upstream of the bubble generating region, and an opening in fluid communication with the supply passage, discharges the liquid.

Applicants submit that even if Nakata et al. shows the structure of a liquid ejection head, nothing in Nakata et al. would teach or suggest a protective coating that has a first region with a substantially uniform thickness along a direction connecting the pair of electrodes, and a second region with a substantially uniform thickness along the direction, with the second region being thinner than the first region.

Moreover, Applicants submit that a combination of Shirato et al. ('762) and Nakata et al., assuming such combination would even be permissible, would fail to teach or suggest a protective coating that has a first and second region with substantially uniform thicknesses, with the second region being thinner than the first region. Accordingly, Applicants submit that Claim 11 is patentable over the art applied against that claim.

Independent Claims 22 and 23 include the same feature of a protective coating that has a first region with a substantially uniform thickness along a direction connecting the pair of electrodes, and a second region with a substantially uniform thickness along the direction, with the second region being thinner than the first region as discussed above in connection with Claims 1 and 11. Accordingly, Claims 22 and 23 are believed to be patentable for at least the same reasons as discussed above in connection with Claims 1 and 11.

A review of the other art of record including has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as

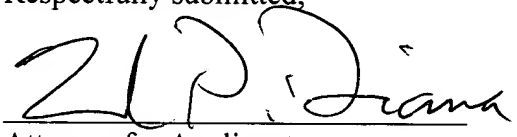
references against the independent claims herein. These claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

1. (Amended) A liquid discharge head comprising a heat generating element contacted with and between a pair of electrodes for generating thermal energy which is used for discharging liquid from a discharge port, and a protective [layer] coating provided on said heat generating element to protect said heat generating element,

wherein said protective [layer] coating has a first region with a substantially uniform [and desired] thickness along a direction connecting said pair of electrodes and a second region with a substantially uniform thickness along the direction, wherein said second region is thinner than [said desired thickness] said first region, and wherein the volume of a liquid [droplets] droplet discharged from said discharge port is changed by changing electric energy applied to said heat generating element.

3. (Amended) A liquid discharge head according to claim 1, wherein said protective [layer] coating is composed of plural [layered] protective [layers] coatings, said first region is composed of said plural [layered] protective [layers] coatings, and [any protective layer] one of said plural [layered] protective [layers] coatings is removed in said second region.

4. (Amended) A liquid discharge head according to claim 3, wherein said second region is formed by forming [the] an upper protective [layer] coating after etching [the] a lower protective [layer] coating.

5. (Amended) A liquid discharge head according to claim 4, wherein said lower protective [layer] coating is composed of phosphosilicate glass film, said upper protective [layer] coating is composed of SiN film, and said etching is conducted with buffered hydrofluoric acid.

11. (Amended) A liquid discharge head comprising a heat generating element contacted with and between a pair of electrodes for generating thermal energy which is used for discharging liquid from a discharge port, a protective [layer] coating provided on said heat generating element to protect said heat generating element and a moving member provided facing said heat generating element and having a free end which is displaced in accordance with generation of a bubble due to said thermal energy,

wherein said protective [layer] coating has a first region with a substantially uniform [and desired] thickness along a direction connecting said pair of electrodes and a second region with a substantially uniform thickness along the direction, wherein said second region is thinner than [said desired thickness] said first region, and wherein the volume of a liquid [droplets] droplet discharged from said discharge port is changed by changing electric energy applied to said heat generating element.

13. (Amended) A liquid discharge head according to claim 11, wherein said protective [layer] coating is composed of plural [layered] protective [layers] coatings, said first

region is composed of said plural [layered] protective [layers] coatings, and [any protective layer] one of said plural [layered] protective [layers] coatings is removed in said second region.

14. (Amended) A liquid discharge head according to claim 13, wherein said second region is formed by forming the upper protective [layer] coating after etching the lower protective [layer] coating.

15. (Amended) A liquid discharge head according to claim 14, wherein said lower protective [layer] coating is composed of phosphosilicate glass film, said upper protective [layer] coating is composed of SiN film, and said etching is conducted with buffered hydrofluoric acid.

19. (Amended) A liquid discharge head according to claim 11, wherein said heat generating element is composed of [polycryatalline] polycrystalline silicon.

21. (Amended) A liquid discharge apparatus [providing] comprising the liquid discharge head according to claim 1 or 11 and a member for [providing] mounting said liquid discharge head.

22. (Amended) A liquid discharge method using a liquid discharge head having a heat generating element contacted with and between a pair of electrodes for generating thermal energy which is used for discharging liquid from a discharge port, and a protective

[layer] coating for protecting [said] the heat generating element, provided on [said] the heat generating element, said protective [layer] coating having a first region with a substantially uniform [and desired] thickness along a direction connecting the pair of electrodes and a second region with a substantially uniform thickness along the direction, wherein said second region is thinner than [said desired thickness] the first region,

wherein a size of a bubble generated on [said] the heat generating element is changed by changing electric energy applied to [said] the heat generating element [while keeping a region of the starting point of bubbling to said second region] to generate a bubble on both the first region and the second region or on only the second region, [whereby] and wherein the volume of a liquid [droplets] droplet discharged from [said] the discharge port is changed.

23. (Amended) A liquid discharge method using a liquid discharge head having a heat generating element contacted with and between a pair of electrodes for generating thermal energy which is used for discharging liquid from a discharge port, a protective [layer] coating for protecting [said] the heat generating element, provided on [said] the heat generating element and a moving member provided facing [said] the heat generating element and having a free end which is displaced in accordance with generation of a bubble due to [said] the thermal energy, [said] the protective [layer] coating having a first region with a substantially uniform [and desired] thickness along a direction connecting the pair of electrodes and a second region with a substantially uniform thickness along the direction, wherein said second region is thinner than [said desired thickness] the first region,

wherein a size of a bubble generated on [said] the heat generating element is changed by changing electric energy applied to [said] the heat generating element [while keeping a region of the starting point of bubbling to said second region] to generate a bubble on both the first region and the second region or on only the second region, [whereby] and wherein the volume of a liquid [droplets] droplet discharged from [said] the discharge port is changed.